

**US-PAT-NO:** 4311957  
**DOCUMENT-IDENTIFIER:** US 4311957 A  
**TITLE:** Measurement of moisture content

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**Abstract Text - ABTX (1):**

Apparatus and method for measuring the moisture content of a material, particularly a tobacco material, in which a microwave signal is divided between first and second signal paths, said first path comprising a sampling capacitor, the dielectric of which comprises the said material, and said second path comprising reference delay means, signals from each of the paths being fed to a phase detector providing an output indicative of waveform time displacement of one of said signals relative to the other of said signals. Advantageously signals from each of the said paths are fed through substantially identical first and second limiting amplifiers directly to the said phase detector. A second microwave signal of a frequency different from, but close to, that of the first-named microwave signal may be mixed with the signals from the sampling capacitor and from the reference delay means, the resultant beat signals of lower frequency being fed to the phase detector.

**Brief Summary Text - BSTX (5):**

The present invention provides a moisture content measuring apparatus comprising a microwave signal generator, first and second signal paths, a signal divider operable to divide a microwave signal from said generator between said first and second paths, a sampling capacitor in said first path arranged to receive fibrous, filamentary or particulate material which provides a dielectric, reference delay means in said second path, and a phase detector arranged to receive signals from said first and second paths and to provide an output indicative of the waveform time displacement of said signals.

**Brief Summary Text - BSTX (6):**

The present invention further provides a method of measuring the moisture content of the material, particularly tobacco, wherein a microwave signal is divided between first and second signal paths, said first path comprising a sampling capacitor the dielectric of which comprises the material, and said second path comprising reference delay means, signals from each of the paths being fed to a phase detector providing an output indicative of waveform time displacement of one of said signals relative to the other of said signals. The method has particular advantage where the material is tobacco, but is applicable also to other materials such as paper-sheet materials and materials comprising small particles of the size of flour, for example cement materials.

**Detailed Description Text - DETX (14):**

It has been determined that for tobacco moisture contents of up to about 43% changes in

the moisture content produce proportional changes in the dielectric constant (at microwave frequencies) of the sampling capacitor 22. Since the phase shifts detected by the detector 28 are proportional to changes in the dielectric constant at the sampling capacitor 22, the former changes are proportional to the moisture content changes. Thus the voltmeter receiving the output signal of the phase detector 28 can be directly calibrated in % moisture units. The purpose of including the reference delay 23 in the second signal path is to ensure that the time phase shift present at the detector 28 is measurable on the straight portions of the voltage waveforms.

**Claims Text - CLTX (1):**

1. Apparatus for the continuous measurement of the moisture content of a loose fibrous, filamentary or particulate material, comprising a microwave signal generator, first and second signal paths, a signal divider operable to divide a microwave signal from said generator between said first and second paths, a sampling capacitor in said first path arranged to receive the said material which provides a dielectric, reference delay means in said second path, and a phase detector arranged to receive signals from said first and second paths and to provide an output indicative of the waveform time displacement of said signals.

**Claims Text - CLTX (4):**

4. A method for the continuous measurement of the moisture content of a loose fibrous, filamentary or particulate material, wherein a microwave signal is divided between first and second signal paths, said first path comprising a sampling capacitor the dielectric of which comprises the said material, and said second path comprising reference delay means, signals from each of the paths being fed to a phase detector providing an output indicative of waveform time displacement of one of said signals relative to the other of said signals.